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Morse Reservoir, Hamilton County, Indiana

Pacific Northwest Environmental Res. Lab.

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April 1976

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16. ABSTRACT

Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

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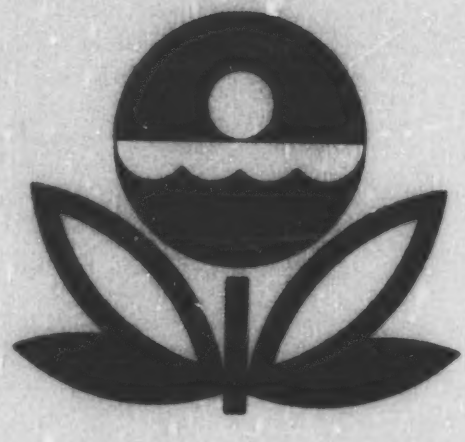

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REPORT
ON
MORSE RESERVOIR
HAMILTON COUNTY
INDIANA
EPA REGION V
WORKING PAPER No. 337

WITH THE COOPERATION OF THE
INDIANA STATE BOARD OF HEALTH
AND THE
INDIANA NATIONAL GUARD
APRIL, 1976

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FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to fresh water lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning {§303(e)}, water quality criteria/standards review {§303(c)}, clean lakes {§314(a,b)}, and water quality monitoring {§106 and §305(b)} activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's fresh water lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the Indiana State Board of Health for professional involvement, to the Indiana National Guard for conducting the tributary sampling phase of the Survey, and to those Indiana wastewater treatment plant operators who provided effluent samples and flow data.

The staff of the Division of Water Pollution Control, Indiana State Board of Health, provided invaluable lake documentation and counsel during the Survey, reviewed the preliminary reports, and provided critiques most useful in the preparation of this Working Paper series.

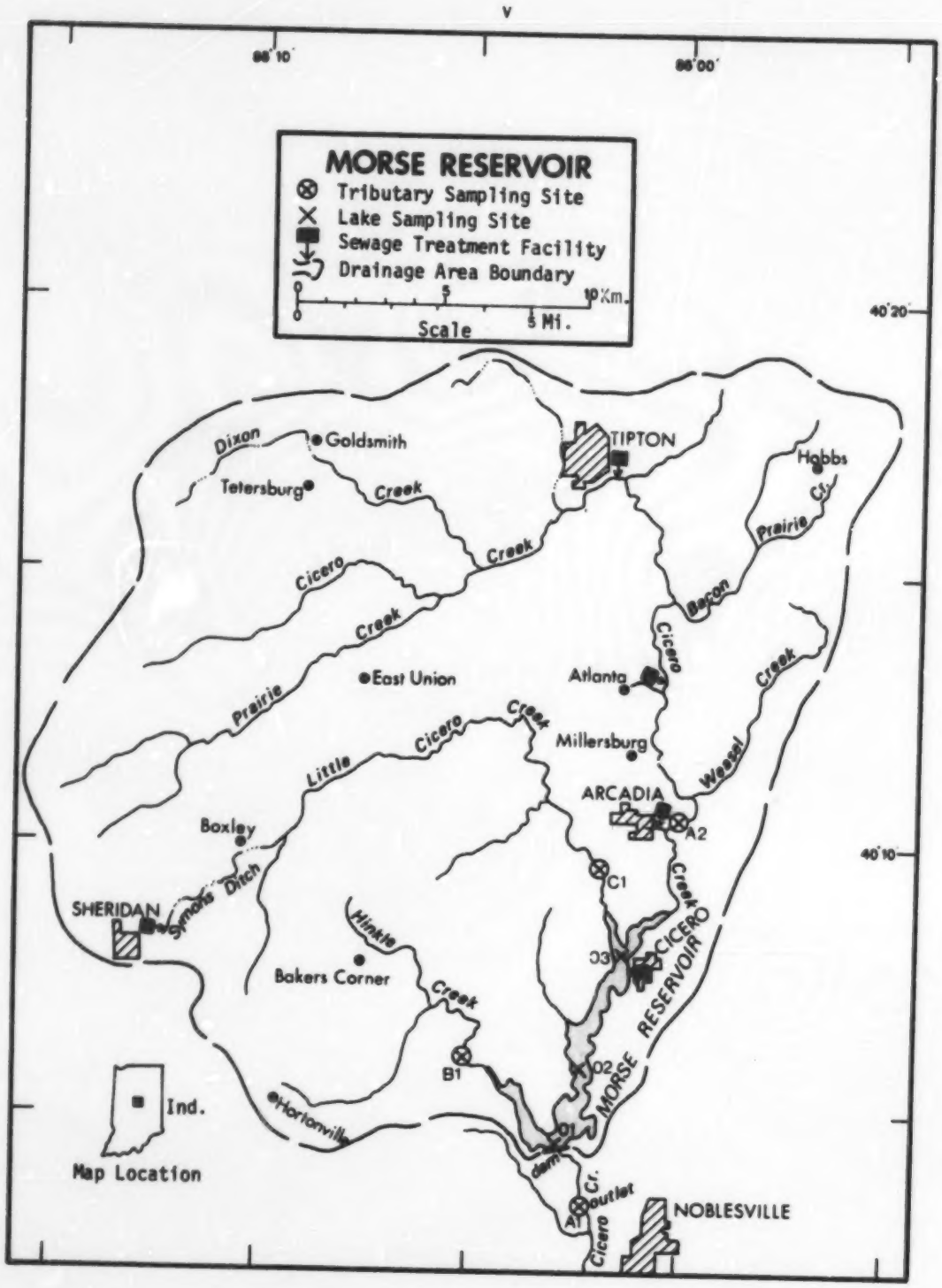
Major General Alfred F. Ahner, Adjutant General of Indiana, and Project Officers Lt. Colonel Charles B. Roberts (Retired) and Colonel Robert L. Sharp, who directed the volunteer efforts of the Indiana National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF INDIANA

LAKE NAME	COUNTY
Bass	Starke
Cataract	Owen, Putnam
Crooked	Steuben
Dallas	LaGrange
Geist	Hamilton, Marion
Hamilton	Steuben
Hovey	Posey
James	Kosciusko
James	Steuben
Long	Steuben
Marsh	Steuben
Mississinewa	Grant, Miami, Wabash
Maxinkuckee	Marshall
Monroe	Brown, Monroe
Morse	Hamilton
Olin	LaGrange
Oliver	LaGrange
Pigeon	Steuben
Sylvan	Noble
Tippecanoe	Kosciusko
Versailles	Ripley
Wawassee	Kosciusko
Webster	Kosciusko
Westler	LaGrange
Whitewater	Union
Winona	Kosciusko
Witmer	LaGrange


MORSE RESERVOIR
Tributary Sampling Site
Lake Sampling Site
Sewage Treatment Facility
Drainage Area Boundary
5
10 Km.
5 Mi.
Scale
86°10'
86°00'
40°20'
40°10'
Dixon
Goldsmith
Tetersburg
Creek
TIPTON
Hobbs
Cr.
Prairie
Cicero
Creek
Bacon
Cicero
Creek
East Union
Atlanta
Prairie
Little
Cicero
Creek
Millersburg
Wetzel
Creek
ARCADIA
A2
Boxley
C1
SHERIDAN
Symons Ditch
Hinkle
Creek
CICERO
RESERVOIR
C3
Bakers Corner
B1
B2
MORSE
RESERVOIR
Ind.
Hortonville
Map Location
dam
A1
outlet
Cr.
Cicero
NOBLESVILLE

MORSE RESERVOIR

STORET NO. 1829

I. CONCLUSIONS

A. Trophic Condition:

Survey data indicate that Morse Reservoir is eutrophic. It ranked twenty-fifth in overall trophic quality when the 27 Indiana lakes sampled in 1973 were compared using a combination of six parameters*. Twenty of the lakes had less and one had the same median total phosphorus, ten had less and one had the same median dissolved phosphorus, all of the other lakes had less median inorganic nitrogen, 25 had less mean chlorophyll a, and 23 had greater mean Secchi disc transparency. Marked depression of hypolimnetic dissolved oxygen occurred at both sampling stations in August, and oxygen was depleted at station 1 in October.

Survey limnologists observed submerged and emergent macrophytes at various locations in the reservoir.

B. Rate-Limiting Nutrient:

The algal assay results indicate that Morse Reservoir was limited by phosphorus at the time the sample was collected (05/10/73). The reservoir data indicate phosphorus limitation in August and October as well.

C. Nutrient Controllability:

1. Point sources--Point-source phosphorus contributions accounted for 32% of the total input to Morse Reservoir during the

* See Appendix A.

sampling year. The wastewater treatment plant at Tipton contributed 25.3% of the total, and the remaining four plants at Atlanta, Arcadia, Cicero, and Sheridan collectively contributed 6.6%.

The present loading of 6.52 $g/m^2/yr$ is over five times that proposed by Vollenweider (Vollenweider and Dillon, 1974) as a eutrophic loading (see page 13). However, the mean hudraulic retention time of the reservoir is a relatively short 56 days, and Vollenweider's model may not apply.

While even complete removal of phosphorus at the listed point sources would still leave a loading of 4.4 $g/m^2/yr$, in view of the questionable applicability of Vollenweider's model and the phosphorus-limited condition of the reservoir, it is likely that a high degree of phosphorus removal at the significant point sources would result in improvement in the trophic condition of the reservoir.

2. Non-point sources--It is calculated that non-point sources contributed 68.0% of the total phosphorus load during the sampling year. Cicero Creek contributed 52.4%, Little Cicero Creek contributed 9.3%, and Hinkle Creek contributed 3.5%. Ungaged tributaries were estimated to have contributed 2.6% of the total.

Cicero Creek had a phosphorus export rate of 55 kg/km^2 during the sampling year. This rate is high compared to the rates of the

other tributaries of the reservoir (see page 12). A number of small towns in the Cicero Creek drainage do not have waste treatment facilities and are served by septic tanks (BonHomme, 1976). These include East Union, Goldsmith, Hobbs, Millersburg, and Tetersburg. It is possible that septic tank drainage from these communities, along with urban drainage from the City of Tipton, account for the higher Cicero Creek phosphorus export rate.

II. LAKE AND DRAINAGE BASIN CHARACTERISTICS†

A. Lake Morphometry††:

1. Surface area: 5.57 kilometers^2.
2. Mean depth: 4.7 meters.
3. Maximum depth: 15.2 meters.
4. Volume: 26.179 x 10^6 m^3.
5. Mean hydraulic retention time: 56 days (based on outflow).

B. Tributary and Outlet:
(See Appendix C for flow data)

1. Tributaries -

Name	Drainage area (km^2)*	Mean flow (m^3/sec)*
Cicero Creek	348.4	3.37
Hinkle Creek	52.1	0.58
Little Cicero Creek	112.1	1.15
Minor tributaries & immediate drainage -	37.1	0.35
Totals	549.7	5.45

2. Outlet -

Cicero Creek	555.3**	5.43

C. Precipitation***:

1. Year of sampling: 122.0 centimeters.
2. Mean annual: 100.8 centimeters.

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† Table of metric conversions--Appendix B.
†† McCollam, 1975.
* For limits of accuracy, see Working Paper No. 175, "...Survey Methods, 1973-1976".
** Includes area of lake.
*** See Working Paper No. 175.

III. LAKE WATER QUALITY SUMMARY

Morse Reservoir was sampled three times during the open-water season of 1973 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from a number of depths at three stations on the lake (see map, page v). During each visit, a single depth-integrated (4.6 m or near bottom to surface) sample was composited from the stations for phytoplankton identification and enumeration; and during the first visit, a single 18.9-liter depth-integrated sample was composited for algal assays. Also each time, a depth-integrated sample was collected from each of the stations for chlorophyll *a* analysis. The maximum depths sampled were 9.8 meters at station 1, 6.1 meters at station 2, and 3.4 meters at station 3.

The sampling results are presented in full in Appendix D and are summarized in the following table.

A. SUMMARY OF PHYSICAL AND CHEMICAL CHARACTERISTICS FOR NORSE RESERVOIR
STORET CODE 1829

PARAMETER	1ST SAMPLING (5/10/73) 3 SITES RANGE	MEAN	MEDIAN	2ND SAMPLING (8/ 2/73) 3 SITES RANGE	MEAN	MEDIAN	3RD SAMPLING (10/15/73) 3 SITES RANGE	MEAN	MEDIAN
TEMP (C)	14.6 - 18.8	16.6	16.3	14.7 - 26.6	24.3	25.8	16.5 - 20.7	19.8	20.1
DISS OXY (MG/L)	8.3 - 12.2	10.2	10.3	0.7 - 12.5	7.2	9.7	0.0 - 9.8	5.2	6.0
CNDCTVY (MCROMO)	510. - 590.	532.	528.	380. - 437.	394.	387.	328. - 434.	365.	344.
PH (STAND UNITS)	8.2 - 8.7	8.4	8.5	7.4 - 9.0	8.5	8.8	7.3 - 8.6	8.0	8.1
TOT ALK (MG/L)	174. - 208.	184.	177.	116. - 197.	136.	121.	136. - 285.	163.	142.
TOT P (MG/L)	0.055 - 0.274	0.097	0.082	0.029 - 0.210	0.070	0.044	0.043 - 0.279	0.119	0.098
ORTHO P (MG/L)	0.006 - 0.035	0.019	0.015	0.004 - 0.018	0.008	0.006	0.003 - 0.022	0.009	0.008
NO2+NO3 (MG/L)	5.070 - 6.390	5.858	6.000	1.290 - 3.540	2.572	2.960	0.100 - 1.720	0.921	0.910
AMMONIA (MG/L)	0.030 - 0.120	0.065	0.050	0.050 - 1.560	0.420	0.070	0.070 - 4.090	0.684	0.145
KJEL N (MG/L)	0.500 - 0.900	0.604	0.500	1.400 - 2.900	2.067	1.900	1.200 - 6.700	1.992	1.300
INORG N (MG/L)	5.120 - 6.450	5.923	6.050	1.400 - 3.600	2.992	3.170	1.020 - 4.190	1.585	1.075
TOTAL N (MG/L)	5.970 - 6.890	6.467	6.500	3.890 - 5.300	4.639	4.850	1.670 - 6.800	2.912	2.610
CHLRPYL A (UG/L)	23.4 - 67.2	39.5	28.0	48.2 - 103.4	68.4	53.5	20.2 - 107.7	60.6	53.9
SECCHI (METERS)	0.5 - 0.9	0.8	0.9	0.4 - 0.9	0.7	0.8	0.4 - 0.8	0.6	0.6

B. Biological characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Algal Units per ml
05/10/73	1. Melosira sp.	7,976
	2. Stephanodiscus sp.	2,705
	3. Chlamydomonas sp.	1,554
	4. Dactylococcopsis sp.	863
	5. Cryptomonas sp.	403
	Other genera	3,534
	Total	17,035
08/02/73	1. Raphidiopsis sp.	56,584
	2. Oscillatoria sp.	27,006
	3. Lyngbya sp.	3,429
	4. Microcystis sp.	3,144
	5. Merismopedia sp.	2,143
	Other genera	5,716
	Total	98,022
10/15/73	1. Oscillatoria sp.	8,377
	2. Raphidiopsis sp.	3,064
	3. Stephanodiscus sp.	2,298
	4. Lyngbya sp.	1,484
	5. Merismopedia sp.	1,197
	Other genera	5,313
	Total	21,733

2. Chlorophyll a -

Sampling Date	Station Number	Chlorophyll a (µg/l)
05/10/73	1	23.4
	2	28.0
	3	67.2
08/02/73	1	48.2
	2	53.5
	3	103.4
10/15/73	1	20.2
	2	53.9
	3	107.7

C. Limiting Nutrient Study:

1. Filtered, and nutrient spiked -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.015	4.980	2.5
0.050 P	0.065	4.980	20.2
0.050 P + 1.0 N	0.065	5.980	27.6
1.0 N	0.015	5.980	2.7

2. Discussion -

The control yield of the assay alga, Selenastrum capricornutum, indicates that the potential primary productivity of Morse Reservoir was moderately high at the time the sample was taken (05/10/73). Also, an eight-fold increase in yield with the addition of only orthophosphorus indicates phosphorus limitation at that time. Note that the addition of only nitrogen resulted in a yield which was not significantly greater than that of the control.

The reservoir data also indicate phosphorus limitation; i.e., the mean inorganic nitrogen/orthophosphorus ratios were 176/1 or greater at all sampling times.

IV. NUTRIENT LOADINGS
(See Appendix E for data)

For the determination of nutrient loadings, the Indiana National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page v), except for the high runoff months of February and March when two samples were collected. Sampling was begun in June, 1973, and was completed in May, 1974.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Indian District Office of the U.S. Geological Survey for the tributary sites nearest the reservoir.

In this report, nutrient loads for sampled tributaries were determined by using a modification of a U.S. Geological Survey computer program for calculating stream loadings*. Nutrient loads shown are those measured minus point-source loads, if any.

Nutrient loads for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were estimated using the nutrient loads at station B-1, in $kg/km^2/year$, and multiplying by the ZZ area in km^2.

The operators of the Arcadia, Tipton, Sheridan, and Cicero wastewater treatment plants provided monthly effluent samples and corresponding flow data. The Atlanta stabilization ponds did not overflow during the sampling year but were drawn down in October; the operator provided samples during the two-day drawdown.

* See Working Paper No. 175.

The estimated phosphorus load from septic tanks was reduced by 50% to adjust for the ban on phosphate detergents that has been in effect in Indiana since 1972.

A. Waste Sources:

1. Known municipal† -

Name	Pop. Served	Treatment	Mean Flow (m^3/d)	Receiving Water
Arcadia	1,338	tr. filter	824.0	Cicero Creek
Atlanta	700	stab. ponds	79.5 (two days)	Cicero Creek
Tipton	5,500	tr. filter	5,579.1	Cicero Creek
Cicero	1,450	act. sludge + pond	690.8*	Morse Reservoir
Sheridan	2,000	act. sludge	1,213.1	Symons Ditch/ Little Cicero Creek

2. Known industrial - A small vegetable canning plant is located north of Tipton; however, it is not believed to be of nutrient significance (BonHomme, 1976).

† Treatment plant questionnaires.
* A recent survey of the Cicero plant revealed the flow meter was recording only 55% of the actual flow (BonHomme, op. cit.); nutrient loads attributed to this source have been adjusted accordingly.

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	kg P/ yr	% of total
a. Tributaries (non-point load) -		
Cicero Creek	19,010	52.4
Hinkle Creek	1,280	3.5
Little Cicero Creek	3,375	9.3
b. Minor tributaries & immediate drainage (non-point load) -	930	2.6
c. Known municipal STP's -		
Arcadia	840	2.3
Atlanta	45	0.1
Tipton	9,190	25.3
Cicero	865	2.4
Sheridan	660	1.8
d. Septic tanks* -	5	<0.1
e. Known industrial - None	-	-
f. Direct precipitation** -	95	0.3
Total	36,295	100.0

2. Outputs -

Lake outlet - Cicero Creek 17,260

3. Net annual P accumulation - 19,035 kg.

* Estimate based on 21 lakeshore dwellings; see Working Paper No. 175.
** See Working Paper No. 175.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	kg N/yr	% of total
a. Tributaries (non-point load) -		
Cicero Creek	556,440	63.3
Hinkle Creek	69,100	7.9
Little Cicero Creek	170,405	19.4
b. Minor tributaries & immediate drainage (non-point load) -	50,085	5.7
c. Known municipal STP's -		
Arcadia	4,140	0.5
Atlanta	105	<0.1
Tipton	16,150	1.8
Cicero	2,295	0.3
Sheridan	3,980	0.4
d. Septic tanks* -	225	<0.1
e. Known industrial - None	-	-
f. Direct precipitation** -	6,015	0.7
Total	878,940	100.0

2. Outputs -

Lake outlet - Cicero Creek 786,085

3. Net annual N accumulation - 92,855 kg.

D. Mean Annual Non-point Nutrient Export by Subdrainage Area:

Tributary	kg P/km^2/yr	kg N/km^2/yr
Cicero Creek	55	1,597
Hinkle Creek	25	1,326
Little Cicero Creek	30	1,520

* Estimate based on 21 lakeshore dwellings; see Working Paper No. 175.
** See Working Paper No. 175.

E. Yearly Loads:

In the following table, the existing phosphorus loadings are compared to those proposed by Vollenweider (Vollenweider and Dillon, 1974). Essentially, his "dangerous" loading is one at which the receiving water would become eutrophic or remain eutrophic; his "permissible" loading is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A mesotrophic loading would be considered one between "dangerous" and "permissible".

Note that Vollenweider's model may not be applicable to water bodies with short hydraulic retention times.

	Total Phosphorus		Total Nitrogen	
	Total	Accumulated	Total	Accumulated
grams/m^2/yr	6.52	3.42	157.8	16.7

Vollenweider phosphorus loadings ($g/m^2/yr$) based on mean depth and mean hydraulic retention time of Morse Reservoir:	
"Dangerous" (eutrophic loading)	1.16
"Permissible" (oligotrophic loading)	0.58

V. LITERATURE REVIEWED

BonHomme, Harold L., 1976. Personal communication (review of preliminary report). IN Div. of Water Poll. Contr., Indianapolis.

McCollam, Archie, 1975. Personal communication (lake morphometry). U.S. Geol. Surv., Indianapolis.

Vollenweider, R. A., and P. J. Dillon, 1974. The application of the phosphorus loading concept to eutrophication research. Natl. Res. Council of Canada Publ. No. 13690, Canada Centre for Inland Waters, Burlington, Ontario.

VI. APPENDICES

APPENDIX A

LAKE RANKINGS

LAKE DATA TO BE USED IN RANKINGS

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P
1805	CATAWACT LAKE	0.038	1.600	466.667	10.744	15.000	0.013
1811	GEIST RESERVOIR	0.074	1.080	472.500	45.950	11.600	0.009
1817	JAMES LAKE	0.024	1.030	434.000	11.533	15.000	0.006
1827	MISSISSINEWA RESERVOIR	0.107	2.400	473.444	15.770	15.000	0.029
1828	MONROE RESERVOIR	0.025	0.325	438.823	6.947	15.000	0.007
1829	HORSE RESERVOIR	0.084	3.325	473.222	56.167	15.000	0.009
1836	WAWASEE LAKE	0.012	0.210	364.500	5.000	14.600	0.003
1837	WEBSTER LAKE	0.025	0.790	431.000	11.500	15.000	0.005
1839	WHITEWATER LAKE	0.084	1.620	470.167	33.083	15.000	0.012
1840	WINONA LAKE	0.035	1.250	444.667	11.211	15.000	0.011
1841	WESTLER LAKE	0.035	0.860	427.125	10.712	15.000	0.013
1842	WITHER LAKE	0.035	0.900	440.333	11.917	15.000	0.011
1843	LAKE MAXINKUCKEE	0.020	0.220	480.400	5.483	15.000	0.003
1844	TIPPECANOE LAKE	0.019	0.195	391.500	6.050	15.000	0.005
1845	DALLAS LAKE	0.029	0.830	413.333	10.067	15.000	0.014
1846	OLIN LAKE	0.012	1.460	403.333	4.867	14.900	0.003
1847	OLIVER LAKE	0.009	0.920	392.000	3.767	14.800	0.004
1848	SYLVAN LAKE	0.170	0.130	469.833	47.480	14.800	0.017
1849	HOVEY LAKE	0.062	1.050	489.333	84.267	7.600	0.024
1850	VERSAILLES LAKE	0.139	1.090	482.000	25.070	14.500	0.019
1851	BASS LAKE	0.040	0.250	471.375	29.367	7.000	0.012
.852	CROOKED LAKE	0.019	0.120	410.111	5.578	15.000	0.005
1853	LAKE JAMES	0.016	0.190	352.444	4.856	15.000	0.005
1854	LONG LAKE	0.284	1.920	442.667	16.100	15.000	0.150
1855	PIGEON LAKE	0.058	1.945	442.667	11.980	15.000	0.015
1856	MARSH LAKE	0.093	0.270	451.333	34.467	15.000	0.055
1857	HAMILTON LAKE	0.033	0.720	413.167	17.450	15.000	0.018

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	300-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P	INDEX NU
1805	CATARACT LAKE	37 (9)	15 (4)	31 (8)	62 (16)	35 (0)	37 (9)	217
1811	GEIST RESERVOIR	27 (7)	35 (9)	15 (4)	12 (3)	92 (24)	62 (16)	243
1817	JAMES LAKE	73 (19)	42 (11)	58 (15)	50 (13)	35 (0)	65 (17)	323
1827	MISSISSINEWA RESERVOIR	12 (3)	4 (1)	8 (2)	38 (10)	35 (0)	8 (2)	105
1828	MONROE RESERVOIR	67 (17)	69 (18)	54 (14)	73 (19)	35 (0)	69 (18)	367
1829	MORSE RESERVOIR	23 (6)	8 (0)	12 (3)	4 (1)	35 (0)	58 (15)	132
1836	WAWASEE LAKE	94 (24)	85 (22)	96 (25)	88 (23)	85 (22)	98 (25)	546
1837	WEBSTER LAKE	67 (17)	62 (16)	62 (16)	54 (14)	35 (0)	81 (21)	361
1839	WHITEWATER LAKE	19 (5)	19 (5)	23 (6)	19 (5)	35 (0)	42 (11)	157
1840	WINONA LAKE	50 (12)	27 (7)	38 (10)	58 (15)	35 (0)	52 (13)	260
1841	WESTLER LAKE	50 (12)	54 (14)	65 (17)	65 (17)	35 (0)	37 (9)	306
1842	WITMER LAKE	50 (12)	50 (13)	50 (13)	42 (11)	35 (0)	52 (13)	274
1843	LAKE MAXINKUCKEE	77 (20)	81 (21)	85 (22)	85 (22)	35 (0)	98 (25)	461
1844	TIPPECANOE LAKE	85 (22)	88 (23)	92 (24)	77 (20)	35 (0)	85 (22)	462
1845	DALLAS LAKE	62 (16)	58 (15)	69 (18)	69 (18)	35 (0)	31 (8)	324
1846	OLIN LAKE	94 (24)	23 (6)	81 (21)	92 (24)	73 (19)	92 (24)	455
1847	OLIVER LAKE	100 (26)	46 (12)	88 (23)	100 (26)	79 (20)	88 (23)	501
1848	SYLVAN LAKE	4 (1)	94 (25)	27 (7)	8 (2)	79 (20)	23 (6)	237
1849	HOVEY LAKE	31 (8)	38 (10)	0 (0)	0 (0)	96 (25)	12 (3)	177
1850	VERSAILLES LAKE	8 (2)	31 (8)	4 (1)	27 (7)	88 (23)	15 (4)	173
1851	BASS LAKE	42 (11)	77 (20)	19 (5)	23 (6)	100 (26)	46 (12)	307
1852	CROOKED LAKE	81 (21)	100 (26)	77 (20)	81 (21)	35 (0)	75 (19)	449
1853	LAKE JAMES	88 (23)	92 (24)	100 (26)	96 (25)	35 (0)	75 (19)	486
1854	LONG LAKE	0 (0)	12 (3)	44 (11)	35 (9)	35 (0)	0 (0)	126
1855	PIGEON LAKE	37 (9)	8 (2)	44 (11)	46 (12)	35 (0)	27 (7)	197
1856	MARSH LAKE	15 (4)	73 (19)	35 (9)	15 (4)	35 (0)	4 (1)	177
1857	HAMILTON LAKE	58 (15)	65 (17)	73 (19)	31 (8)	35 (0)	19 (5)	281

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
1	1836	WAWASEE LAKE	546
2	1847	OLIVER LAKE	501
3	1853	LAKE JAMES	486
4	1844	TIPPECANOE LAKE	462
5	1843	LAKE MAXINKUCKEE	461
6	1846	OLIN LAKE	455
7	1852	CROOKED LAKE	449
8	1828	MONROE RESERVOIR	367
9	1837	WEBSTER LAKE	361
10	1845	DALLAS LAKE	324
11	1817	JAMES LAKE	323
12	1851	BASS LAKE	307
13	1841	WESTLER LAKE	306
14	1857	HAMILTON LAKE	281
15	1842	WITHER LAKE	279
16	1840	WINONA LAKE	260
17	1811	GEIST RESERVOIR	243
18	1848	SYLVAN LAKE	237
19	1805	CATARACT LAKE	217
20	1855	PIGEON LAKE	197
21	1856	MARSH LAKE	177
22	1849	HOVEY LAKE	177
23	1850	VERSAILLES LAKE	173
24	1839	WHITEWATER LAKE	157
25	1829	MORSE RESERVOIR	132
26	1854	LONG LAKE	126
27	1827	MISSISSINEWA RESERVOIR	105

APPENDIX B

CONVERSION FACTORS

CONVERSION FACTORS

Hectares x 2.471 = acres

Kilometers x 0.6214 = miles

Meters x 3.281 = feet

Cubic meters x 8.107×10^{-4} = acre/feet

Square kilometers x 0.3861 = square miles

Cubic meters/sec x 35.315 = cubic feet/sec

Centimeters x 0.3937 = inches

Kilograms x 2.205 = pounds

Kilograms/square kilometer x 5.711 = lbs/square mile

APPENDIX C

TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR INDIANA 03/29/76

LAKE CODE 1829 MORSE RESERVOIR

TOTAL DRAINAGE AREA OF LAKE(SQ KM) 555.3

TRIBUTARY	SUB-DRAINAGE AREA(SQ KM)	NORMALIZED FLOWS(CMS) JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
1829A1	558.1	5.97	7.73	10.34	11.33	5.32	5.69	3.51	1.83	1.03	2.17	4.19	6.34	5.43
1829A2	348.4	3.85	4.93	6.43	6.34	3.48	3.54	2.63	0.92	0.69	1.42	2.74	3.65	3.37
1829B1	52.1	0.697	0.912	1.048	1.161	0.592	0.677	0.385	0.193	0.082	0.170	0.422	0.626	0.577
1829C1	112.1	1.25	1.63	2.02	2.11	1.13	1.32	1.08	0.46	0.18	0.39	0.94	1.32	1.15
1829ZZ	37.3	0.442	0.535	0.765	0.711	0.459	0.351	0.210	0.071	0.068	0.071	0.181	0.348	0.349

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 555.3
SUM OF SUB-DRAINAGE AREAS = 549.9

TOTAL FLOW IN = 65.63
TOTAL FLOW OUT = 65.45

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
1829A1	6	73	8.467	9	18.024				
	7	73	1.189	7	1.359				
	8	73	8.014	12	15.433				
	9	73	0.986	9	0.311				
	10	73	3.002	15	1.812				
	11	73	11.270	10	0.821				
	12	73	15.971	9	6.570				
	1	74	26.108	13	3.540				
	2	74	10.449	9	7.391	24	17.500		
	3	74	11.836	10	7.759	17	5.975		
	4	74	14.102	9	23.531				
	5	74	4.984	18	2.152				
1829A2	6	73	4.474	9	4.757				
	7	73	0.708	7	0.765				
	8	73	4.984	12	13.649				
	9	73	0.481	9	0.198				
	10	73	1.218	15	0.906				
	11	73	7.589	10	0.680				
	12	73	9.996	9	4.446				
	1	74	16.905	13	4.878				
	2	74	6.796	9	4.582	24	9.628		
	3	74	6.938	10	4.163	17	2.577		
	4	74	6.796	9	16.112				
	5	74	8.891	18	15.065				

TRIBUTARY FLOW INFORMATION FOR INDIANA 03/29/76

LAKE CODE 1829 MORSE RESERVOIR

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
182981	6	73	1.246	9	0.708				
	7	73	0.176	7	0.170				
	8	73	0.680	12	4.842				
	9	73	0.144	9	0.074				
	10	73	0.595	15	0.284				
	11	73	1.133	10	0.119				
	12	73	1.529	9	0.368				
	1	74	2.492	13	0.453				
	2	74	1.019	9	0.680	24	1.184		
	3	74	1.501	10	0.708	17	0.850		
	4	74	1.331	9	2.917				
	5	74	1.444	18	4.219				
1829C1	6	73	1.784	9	1.388				
	7	73	0.249	7	0.252				
	8	73	1.246	12	4.361				
	9	73	0.187	9	0.028				
	10	73	1.076	15	0.510				
	11	73	2.492	10	0.340				
	12	73	3.313	9	1.161				
	1	74	4.729	13	0.736				
	2	74	1.841	9	1.184	24	2.322		
	3	74	2.718	10	1.359	17	1.218		
	4	74	2.492	9	5.663				
	5	74	3.030	18	5.125				
1829ZZ	6	73	0.906	9	0.510				
	7	73	0.125	7	0.122				
	8	73	0.848	12	3.455				
	9	73	0.102	9	0.054				
	10	73	0.425	15	0.340				
	11	73	0.793	10	0.085				
	12	73	0.110	9	0.263				
	1	74	1.784	13	0.040				
	2	74	0.736	9	0.538	24	0.821		
	3	74	1.076	10	0.538	17	0.651		
	4	74	0.963	9	0.210				
	5	74	1.019	18	3.002				

APPENDIX D

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 76/03/30

182901
40 04 25.0 086 03 00.0 3
MORSE RESERVOIR
18057 INDIANA
051991

11EPALES 2111202
0036 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT K-JEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
73/05/10	12 22	0000	16.4		36	510	8.50	175	0.040	0.500	5.710	0.007
	12 22	0009	16.3	11.3		510	8.50	176	0.040	0.500	5.900	0.006
	12 22	0015	15.7	10.3		520	8.30	174	0.030	0.500	6.020	0.006
	12 22	0032	14.6	8.3		525	8.30	177	0.110	0.500	6.000	0.015
73/08/02	15 30	0000	26.0		30	380	8.90	118	0.060	1.000	3.500	0.007
	15 30	0005	25.9	10.6		380	8.90	117	0.060	1.500	3.540	0.006
	15 30	0015	25.5	9.7		380	8.70	116	0.050	1.400	3.540	0.005
	15 30	0030	14.7	0.7		480	7.50	197	1.460	2.300	2.020	0.004
73/10/15	11 00	0000	20.2		30	328	7.90	136	0.350	1.200	0.670	0.009
	11 00	0005	20.2	4.6		329	7.80	137	0.360	1.300	0.680	0.006
	11 00	0015	20.0	4.0		329	7.70	136	0.400	1.200	0.670	0.007
	11 00	0025	19.3	0.0		370	7.40	179	1.980	3.300	0.190	0.018
	11 00	0031	16.5	0.0		434	7.30	285	4.090	6.700	0.180	0.022

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/05/10	12 22	0000	0.055	23.4
	12 22	0009	0.066	
	12 22	0015	0.060	
	12 22	0032	0.073	
73/08/02	15 30	0000	0.036	48.2
	15 30	0005	0.033	
	15 30	0015	0.029	
	15 30	0030	0.031	
73/10/15	11 00	0000	0.043	20.2
	11 00	0005	0.054	
	11 00	0015	0.058	
	11 00	0025	0.111	
	11 00	0031	0.279	

52

STORET RETRIEVAL DATE 76/03/30

102902
40 05 50.0 086 02 27.0 3
MORSE RESERVOIR
18057 INDIANA
051991

11EPALES 2111202
0023 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
73/05/10	12 55	0000	17.0		36	510	8.70	175	0.040	0.600	6.020	0.014
	12 55	0009	16.3	10.5		510	8.50	183	0.040	0.500	6.320	0.022
	12 55	0015	16.1	9.8		520	8.20	181	0.060	0.500	6.390	0.033
	12 55	0020	15.4	8.6		520	8.50	177	0.100	0.600	6.270	0.033
73/08/02	16 00	0000	26.4		35	387	9.00	121	0.070	1.900	2.960	0.006
	16 00	0005	25.8	10.1		384	8.80	120	0.060	1.800	3.050	0.005
	16 00	0019	22.2	0.7		437	7.40	181	1.560	2.900	1.610	0.011
73/10/15	11 25	0000	20.7		24	341	8.20	140	0.130	2.100	0.930	0.004
	11 25	0005	20.5	6.0		345	8.10	142	0.140	1.400	0.910	0.004
	11 25	0010	20.5	6.4		343	8.10	141	0.140	1.300	0.910	0.003
	11 25	0015	20.5	6.6		342	8.10	141	0.150	1.200	0.930	0.003

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/05/10	12 55	0000	0.068	28.0
	12 55	0009	0.082	
	12 55	0015	0.090	
	12 55	0020	0.096	
73/08/02	16 00	0000	0.052	53.5
	16 00	0005	0.044	
	16 00	0019	0.069	
73/10/15	11 25	0000	0.103	53.9
	11 25	0005	0.094	
	11 25	0010	0.090	
	11 25	0015	0.090	

92

STORET RETRIEVAL DATE 76/03/30

182903
40 07 58.0 086 01 28.0 3
MORSE RESERVOIR
18057 INDIANA

051991

11EPALES 2111202
0014 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
73/05/10	13 20	0000	18.8		20	560	8.60	193	0.050	0.900	5.070	0.015
	13 20	0005	18.1	12.2		580	8.30	200	0.080	0.700	5.350	0.022
	13 20	0011	17.5	10.4		590	8.20	208	0.120	0.900	5.390	0.035
73/08/02	16 20	0000	26.6	12.5	14	480	9.00	127	0.110	2.600	1.290	0.018
	16 20	0009	25.6	6.3		480	8.30	129	0.350	2.400	1.640	0.014
73/10/15	11 45	0000	19.9		16	480	8.60	173	0.070	1.700	1.630	0.010
	11 45	0005	19.5	9.6		488	8.40	175	0.080	1.200	1.710	0.011
	11 45	0008	19.6	9.8		486	8.40	176	0.080	1.300	1.720	0.010

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/05/10	13 20	0000	0.086	67.2
	13 20	0005	0.274	
	13 20	0011	0.120	
73/08/02	16 20	0000	0.210	103.4
	16 20	0009	0.130	
73/10/15	11 45	0000	0.182	107.7
	11 45	0005	0.162	
	11 45	0008	0.162	

APPENDIX E

TRIBUTARY and WASTEWATER TREATMENT PLANT DATA

STORET RETRIEVAL DATE 76/03/30

1829A1
40 03 20.0 086 02 30.0 4
CICERO CREEK
18 7.5 NOBLESVILLE
O/MOHSE HES 051991
HWY 38 BRDG 1 MI NW OF JCT WITH HWY 32
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/06/09	13 17		4.300	0.820	0.027	0.006	0.055
73/07/07	11 00		4.500	1.050	0.054	0.010	0.050
73/08/12	09 10		2.300	0.100K	0.021	0.005K	0.050
73/09/09	13 15		0.600	1.150	0.046	0.007	0.050
73/10/15	11 00		0.670	1.130	0.198	0.006	0.045
73/11/10	14 00		0.960	1.000	0.232	0.005K	0.040
73/12/09	13 09		4.400	1.100	0.104	0.096	0.135
74/01/13	07 35		4.800	0.700	0.056	0.136	0.195
74/02/09	09 45		3.700	0.600	0.077	0.097	0.165
74/02/24	10 00		4.100	0.700	0.095	0.080	0.145
74/03/10	09 15		4.700	0.800	0.095	0.075	0.115
74/03/17	09 15		4.400	1.000	0.090	0.070	0.115
74/04/09	08 10		4.700	4.500	0.175	0.100	0.138
74/05/18			5.280	1.100	0.070	0.015	0.105

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/03/30

1829A2
40 10 30.0 086 00 01.0 4
CICERO CREEK
18 7.5 ARCADIA
I/HORSE RES 051991
MT PLEASANT RD BRDG .1 M S OF E 266 ST
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/06/09	13 50		9.000	0.840	0.086	0.105	0.190
73/07/07	12 30		3.500	0.920	0.150	0.118	0.175
73/08/12	10 00		2.700	0.520	0.420	0.290	0.970
73/09/09	14 00		1.160	1.000	0.105	0.810	0.910
73/10/15	13 00		1.660	0.800	0.025	0.032	0.055
73/11/10	14 40		3.200	0.300	0.016	0.320	0.320
73/12/09	13 45		5.700	0.800	0.056		0.110
74/01/13	09 00		6.100	0.500	0.128	0.120	0.145
74/02/09	10 55		5.040	0.600	0.085	0.105	0.135
74/02/24	11 30		4.100	0.800	0.110	0.080	0.145
74/03/10	10 15		6.600	0.800	0.065	0.075	0.125
74/03/17	10 15		5.880	1.200	0.075	0.080	0.150
74/04/09	08 45		6.000	1.100	0.055	0.080	0.170
74/05/18			5.010	1.100	0.055	0.015	0.100

STORET RETRIEVAL DATE 76/03/30

182981
40 06 02.0 086 05 12.0 4
MINKLE CREEK
18 7.5 NOBLESVILLE
T/MORSE RES 051991
E 216TH ST BRDG .2 MI E OF MINKLE RD
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/06/09	13 20		7.400	0.600	0.080	0.046	0.095
73/07/07	11 30		3.100	1.100	0.160	0.120	0.160
73/08/12	09 25		2.080	2.400	0.066	0.132	
73/09/09	13 30		0.610	0.560	0.042	0.044	0.065
73/10/15	12 00		1.740	0.500	0.012	0.032	0.050
73/11/10	14 15		1.500	0.250	0.008	0.012	0.020
73/12/09	13 15		3.400	0.300	0.024	0.020	0.045
74/01/13	08 00		3.360	0.400	0.048	0.016	0.025
74/02/09	09 50		3.300	0.500	0.025	0.020	0.030
74/02/24	10 30		4.200	0.900	0.105	0.090	0.145
74/03/10	09 30		3.500	0.600	0.025	0.020	0.035
74/03/17	09 30		3.400	0.500	0.015	0.020	0.045
74/04/09	08 20		3.600	0.800	0.025	0.050	0.125
74/05/18			5.100	0.700	0.060	0.015	0.070

STORET RETRIEVAL DATE 76/03/30

1829C1
40 09 40.0 086 02 00.0 4
LITTLE CICERO CREEK
18 7.5 ARCADIA
T/MORSE RES 051991
E 256TH ST BRDG .2 MI W OF SHERER AVE
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/06/09	13 40		8.600	0.400	0.069	0.061	0.115
73/07/07	12 00		3.100	0.990	0.132	0.115	0.155
73/08/12	09 40		2.800	3.100	0.074	0.170	
73/09/09	13 45		0.378	0.770	0.048	0.100	0.160
73/10/15	12 30		1.740	0.600	0.007	0.031	0.055
73/11/10	14 30		2.760	0.350	0.008	0.016	0.035
73/12/09	13 35		4.800	1.100	0.040	0.048	0.070
74/01/13	08 30		5.200	0.200	0.008	0.024	0.035
74/02/09	10 45		4.620	0.900	0.330	0.060	0.108
74/02/24	11 10		4.100	0.800	0.130	0.090	0.150
74/03/10	10 00		4.900	0.600	0.025	0.050	0.105
74/03/17	10 00		5.040	0.700	0.025	0.050	0.115
74/04/09	08 40		4.600	1.200	0.060	0.085	0.230
74/05/18			5.200	1.200	0.070	0.020	0.110

STORET RETRIEVAL DATE 76/03/30

182921 AS182921 P001450
40 07 44.0 086 01 15.0 4
CICERO
18 7.5 ARCADIA
D/MORSE RESERVOIR 051991
MORSE RESERVOIR
11EPALES 2141204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
73/06/19 11 00 CP(T)- 73/06/19 16 00			0.360	5.750	0.044	0.520	2.700	0.156	0.148
73/07/24 11 00 CP(T)- 73/07/24 16 00			1.890	0.560	0.052	.980	2.400	0.249	0.145
73/08/29 11 00 CP(T)- 73/08/29 16 00			1.820	1.900	0.074	1.200	1.580	0.151	0.163
73/10/03 11 00 CP(T)- 73/10/03 16 00			2.730	6.900	0.010K	2.600	3.000	0.131	0.151
73/11/01 11 00 CP(T)- 73/11/01 16 00			5.100	1.700	0.010K	2.100	2.300	0.156	0.139
74/02/01 11 00 CP(T)- 74/02/01 16 00			0.040	1.300	0.040K	0.720	2.100	0.340	0.270
74/03/05 11 00 CP(T)- 74/03/05 16 00			2.240	2.400	0.086	1.190	1.400	0.338	0.291
74/04/10 15 00			4.600	1.200	0.050K	0.435	0.970	0.310	0.271
74/05/13 10 30			4.900	1.000K	0.100	1.150	1.400	0.174	0.165
74/06/07 14 30			5.900	2.050	0.100	1.100	1.450	0.196	0.171
74/07/10 14 00			0.120	4.600	0.050K	1.800	2.400	0.136	0.145
74/08/28 15 00			0.080	6.000	0.050K		2.400	0.141	0.131

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/03/30

1829CA AS1829CA P002000
40 07 45.0 086 11 45.0 4
SHERIDAN
18 HAMILTON CO MAP
T/HORSE RESERVOIR 051992
LITTLE CICERO CREEK
11EPALES 2141204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
73/06/20 CP(T)-	08 00		7.800	1.170	0.005K	1.120	1.200	0.380	0.250
73/06/20	20 00		11.200	2.625	0.088	2.400	2.700	0.300	0.250
73/07/22	08 00		8.500	0.860	0.120	1.830		0.295	0.300
73/08/22	08 00		6.700	7.200	0.070	3.050	3.300	0.300	0.250
73/09/24	15 00		13.600	1.600	0.037	3.500	3.900	0.230	0.250
73/10/22	08 00		5.700	1.100	0.023	0.470	1.100	0.557	0.270
73/11/28	08 00		7.700	0.720	0.025	1.350	1.500	0.400	0.340
73/12/24	08 00		5.880	0.500	0.040K	0.630	0.760	0.460	0.400
74/01/29	08 00		6.600	1.000K	0.050K	0.300	0.660	0.450	0.250
74/02/26	08 00		3.600	2.000	0.050K	0.750	1.050	0.396	0.406
74/03/27	08 00		4.800	1.800	0.100	1.050	1.400	0.292	0.400
74/04/27	08 30		6.100	1.300	0.050K	0.650	0.650	0.456	0.400
74/05/28	08 00		8.500	4.550	0.110	1.500	1.730	0.390	0.400
74/06/30	08 00								

34

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/03/30

1829AC TF1829AC P005500
40 17 17.0 086 01 50.0 4
TIPTON
18 TIPTON CO MAP
T/MORSE RESERVOIR 051792
CICERO CREEK
11EPALES 2141204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
74/06/20	09 00		2.500	5.300	0.170	1.846	3.300	1.500	1.650
CP(T)-									
74/06/20	15 00								

STORET RETRIEVAL DATE 76/03/30

1829AC TF1829AC P005580
40 17 17.0 086 01 58.0 4
TIPTON
18 TIPTON CO MAP
T/HORSE RESERVOIR 051702
CICERO CREEK
11EPALES 2141284
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
73/06/12	11 00								
CP(T)- 73/06/12	16 00		2.900	6.100	0.110	3.000	4.700	1.700	1.430
73/07/12	10 30								
CP(T)- 73/07/12	15 30		2.000	5.300	0.050	3.700	6.400	1.300	1.600
73/08/21	11 00								
CP(T)- 73/08/21	16 00		2.100	5.000	0.010	1.940		1.400	1.200
73/09/05	10 00								
CP(T)- 73/09/05	16 00		1.300	0.400	0.120	3.200		1.300	1.520
73/10/19	09 00								
CP(T)- 73/10/19	15 00		3.400	6.100		3.000	4.000	1.000	1.300
73/11/21	08 00								
CP(T)- 73/11/21	15 00		1.200	4.400	0.210	3.360	3.750	1.200	1.100
73/12/12	09 30								
CP(T)- 73/12/12	15 30		3.360	5.000	0.094	4.000	6.000	1.500	1.230
74/01/16	09 30								
CP(T)- 74/01/16	15 30		2.600	5.400	0.040	3.120	4.000	1.500	1.400
74/02/13	09 00								
CP(T)- 74/02/13	15 00		2.320	6.900	0.110	3.600	4.750	1.700	1.600
74/03/14	08 00								
CP(T)- 74/03/14	14 00		4.000	9.000			7.600	1.600	1.000
74/04/15	09 00								
CP(T)- 74/04/15	15 00		2.240	1.000K	0.094	2.600	3.450	1.400	1.600
74/05/15	09 00								
CP(T)- 74/05/15	15 00		3.120	1.500	0.160	1.300	1.750	2.000	1.650

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/03/30

1829A8 PD1829A8 P000700
40 13 00.0 086 01 12.0 4
ATLANTA
18 7.5 ARCADIA
T/HORSE RESERVOIR 051991
CICERO CREEK
11EPALES 2141204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
73/10/23	10 00		0.040	4.400	0.154	1.350	1.850	0.022	0.021
73/10/24	10 00		0.036	2.900	0.007	1.150	1.400	0.022	0.021

STORET RETRIEVAL DATE 76/03/30

1829AA TF1829AA P001338
40 10 30.0 086 00 47.0 4
ARCADIA
18 7.5 ARCADIA
T/HORSE RESERVOIR 051991
CICERO CREEK
11EPALES 2141204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
73/06/29	09 30		9.800	1.470	0.270	1.050	1.650	0.259	0.198
73/07/30	10 00		8.100	12.600	0.880	4.800	5.200	0.106	0.149
73/08/30	16 00		4.800	14.250	2.510	4.640	5.600	0.168	0.205
73/10/29	10 00		5.300	11.500	0.400	2.940	5.200	0.160	0.200
73/11/30	16 00		10.000	1.700	0.120	1.000	1.600	0.270	0.200
73/12/28	09 00		6.500		0.059	0.510	0.540	0.290	0.230
74/02/27	15 00		3.000	11.000	0.610	1.850	2.700	0.240	0.240
74/04/15	16 00		3.600	1.200	0.220	1.750	2.600	0.230	0.250
74/05/22	13 30		8.100	3.800	0.170	0.750	1.250	0.260	0.240
74/06/20	10 30		5.800	9.800	0.420	1.840	2.900	0.210	0.240
74/07/23	13 30		0.280	10.000	0.820	2.500	3.200	0.200	0.220
74/08/14	14 20		10.100	14.000	0.740	4.400	5.300	0.200	0.240